HYDROZOA FROM SHIPS' HULLS AND EXPERIMENTAL PLATES IN CAPE TOWN DOCKS

by

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(With 3 figures and 1 table in the text)

Introduction

Most of the material described in this paper was collected during a survey of fouling organisms conducted in Table Bay harbour during the years 1946 to 1950, the results of which were published in 1952. During this period some 26 vessels were examined after dry-docking in Cape Town, and several series of experimental plates were exposed for varying lengths of time in the water of the harbour. In recent years a few additions have been made to the collection as opportunity offered.

A study of the fouling community shows that the number of species which settles on a floating structure is small in comparison with that in surrounding waters. Thus, only 14 species of hydroids have occurred in the fouling as against 65 species reported from False Bay near by (Millard 1957). Moreover some species which are common on ships' hulls and in harbour areas are seldom encountered elsewhere (see also discussion). The fouling organisms, in fact, make up a definite community of their own, the individuals of which are particularly suited by their physiological or reproductive abilities to occupy this ecological niche.

One surprising feature about the hydroid community is the fact that some families, such as the Bougainvilliidae, Tubulariidae and Campanulariidae, are well represented, in numbers if not in species, and others, such as the Sertulariidae and the statoplean Plumulariidae, are conspicuous by their absence. The reason for this is not clear. Species which produce free medusae and species with fixed gonophores are both represented and in approximately equal numbers.

Grants from the staff research fund of the University of Cape Town made possible the original work on fouling organisms and the purchase of microscopic apparatus for the subsequent study of the material. The cost of publication was partly defrayed by a grant from the publications fund of the University. Type material has been deposited in the South African Museum, Cape Town (S.A.M.).

List of Species

Tubulariidae	*Tubularia larynx* Ellis & Solander
	Tubularia warreni Ewer
Corynidae	*Sarsia eximia* (Allman)
Bougainvilliidae	*Bougainvillia macloviana* (Lesson)
	Bougainvillia ramosa (van Beneden)
	Rhizorhagium navis n. sp.
Campanulariidae	*Laomedea angulata* (Hincks)
	Laomedea lovéni Allman
	Obelia bicuspidata Clarke
	Obelia dichotoma (Linn.)
	Obelia geniculata (Linn.)
Campanulinidae	*Lovenella chiquitita* Millard
Plumulariidae	*Kirchenpaueria pinnata* (Linn.)
	Plumularia setacea (Ellis & Solander)

Family **Tubulariidae**

Tubularia larynx Ell. & Sol. 1786

Tubularia larynx. Allman 1872, p. 406, pl. 21. Hawes 1955, p. 333, figs. 1–5 (synonymy).

Material. One fruiting colony collected 24/5/47. Record number: SH 188.

Description. Stems branching, reaching a maximum height of 3 cm., annulated at intervals. Coenosarc with 2–4 internal longitudinal ridges of endoderm, which may meet in the centre and divide the interior into canals. The partitions themselves sometimes tubular.

Hydranth with 14–27 proximal and 15–19 distal tentacles. Distal tentacles in a single verticil.

Blastostyles in 1 or 2 rows. Gonophores with 3–4 rounded tentacular processes at distal end, less pronounced in the male than in the female.

Remarks. This species has only once before been reported from South Africa, from the Agulhas Bank by Stechow 1925.

Tubularia warreni Ewer 1953

Tubularia crocea. Millard 1952, p. 420, 428, 440, fig. 3.
T. warreni Ewer 1953, p. 351, figs. 1–4. Millard 1959, p. 299.

Material. 10 colonies from ships' hulls and 1 from experimental plates, most of them very rich, and reaching a maximum height of 7–8 cm. Record numbers: SH 2, 11, 12, 15, 122, 176, 254, 257, 394, 429A, 430A.

Description. Stem with 2–5 (usually 2 or 3) internal longitudinal ridges of endoderm, which when strongly developed may contain tubes. Mature

hydranth with 12–31 tentacles in proximal row, and 13–24 in distal row. Largest hydranths reaching 6 mm. in length from distal tentacles to base of dilation, and 2·5 mm. in basal diameter exclusive of tentacles.

Male gonophores usually without tentacular processes, but very occasionally with 4–5 small conical processes. Female gonophores with 8 flattened tentacular processes, of variable size. Actinula with 6–12 proximal tentacles and up to 6 oral tentacles at liberation.

Nematocysts as described by Ewer.

Remarks. The importance of this species as a fouling organism was discussed by Millard 1952 under the name of *T. crocea.* It is now known that the colonies which occur so abundantly in the dock area are definitely Ewer's species as established by the examination of nematocysts in living specimens. The early material brought in by ships was unfortunately not examined alive, and the undischarged nematocysts of preserved specimens are of no help in identification. No details of structure distinguish the latter from *T. warreni*, and they have thus all been included with this species. Moreover, all the ships concerned had had the opportunity of picking up the species in South Africa at some time during their voyages.

The species is common on the hulls of ships and often forms a thick carpet over the entire surface. It settles throughout the year, but mainly in spring and summer. Ripe gonophores have been observed in all months from January to August, and probably occur in the rest of the year too. Young hydranths may bear gonophores at a height of about 1 cm., and about 35 days after settlement.

As Ewer has suggested a study of the nematocysts in *T. mesembryanthemum* may show it to be synonymous with *T. warreni*, and the former is well known in Europe. It has not been recorded from South Africa.

T. crocea is distinguished from *T. warreni* only by its nematocysts and a few minor features of the anatomy such as the absence of endodermal ridges in the stem. This species has been reported from Lüderitz Bay by Broch 1914, and from a ship in the south Atlantic by Vanhöffen 1910, who suggests that the individuals may have settled in Simonstown (False Bay). It is possible that in both these cases the material was in reality *T. warreni.* (See also discussion.)

Family **Corynidae**

Sarsia eximia (Allman) 1859

Syncoryne eximia. Allman 1872, p. 282, pl. 5. Hincks 1868, p. 50; pl. 9, fig. 2.

Material. 4 samples from ships' hulls, among them one with numerous young medusae, and another with 2 fruiting hydranths. Record numbers; SH 1C, 123, 261B, 305.

Description. Stems tangled and richly branching, reaching a maximum height of about 2 cm. Structure as described by Allman and Hincks. Hydranths

bearing medusa buds at various stages of development, the oldest almost ready for liberation but with the tentacles still unfurled. Medusa buds observed in January.

Nematocysts: stenoteles, varying in size from 8·1 × 5·4 μ to 15·3 × 9·9 μ.

Remarks. This is the first sure record of the species from South Africa. Non-fruiting material was reported by Day, Millard and Harrison 1952 from Knysna Estuary as *Syncoryne ?eximia*, and by Millard 1957 from False Bay as *Coryne* sp.

Family **Bougainvilliidae**

Bougainvillia macloviana (Lesson) 1836

Fig. 1, A–C

Perigonimus maclovianus. Vanhöffen 1910, p. 284, fig. 10.
Bougainvillia macloviana. Jäderholm 1923, p. 3. Browne and Kramp 1939, p. 284; pl. 14, fig. 6; pl. 15, fig. 7–14.

Material. Two small colonies, both fruiting. Record numbers: SH 196, 255B.

Description. Hydrorhiza forming a branching network over the surface of barnacle shells and ascidian tests.

Stem unfascicled, slender, unbranched or branching irregularly several times, narrower at base than at summit, reaching a maximum height of 3–4 mm. Perisarc roughly corrugated at base and on origin of branches, smooth or wrinkled for the rest, continued over hydranth as far as the bases of the tentacles as a 'pseudohydrotheca', covered throughout with adherent silt.

Hydranth with 8–12 tentacles in two close alternating verticils. Hypostome conical.

Gonophores arising singly from the stems, branches or hydrorhiza, on pedicels of variable length (usually shorter than gonophore), more or less spherical when mature, completely enclosed in gelatinous perisarc. Oldest medusa with 4 spherical marginal bulbs each bearing 2 black ocelli and 2 tentacles, a conical hypostome with a quadrangular base to its cavity, and 4 unbranched capitate oral tentacles.

Nematocysts of 2 types:

i. Undetermined heteronemes, 6·0–6·5 × 2·0–2·5 μ.

ii. Desmonemes, 3·5–4·0 × 2·0–3·0 μ.

Measurements (mm., preserved)	SH 196	SH 255B
Stem, diameter including perisarc	0·05–0·10	0·035–0·12
Pseudohydrotheca, height	0·13–0·23	0·20–0·40
diameter	0·09–0·16	0·12–0·23
Gonophore (without perisarc), height reaching	0·24	0·30
diameter, reaching	0·26	0·36

Remarks. There are certain slight differences between the two colonies, though not sufficient to justify specific separation.

SH 255B is the sparser of the two, and the stem branches at most 2 or 3 times. The hydranths are slightly larger. The oldest medusa is ready for liberation (fig. 1B); it has lost its connexion with the coenosarc of the pedicel and has two of its tentacles unfurled.

SH 196 is a more luxuriant colony and is richly supplied with gonophores, though these are not quite so advanced. Some have 4, and some 8, ocelli and the marginal tentacles are still inturned. Oral tentacles are present in the largest gonophores but could only be recognized in sections. Many empty perisarcal capsules show that a crop of medusae has recently escaped.

The gonophores were observed in May and July.

The only previous record of the species from South Africa is that of Jäderholm 1923.

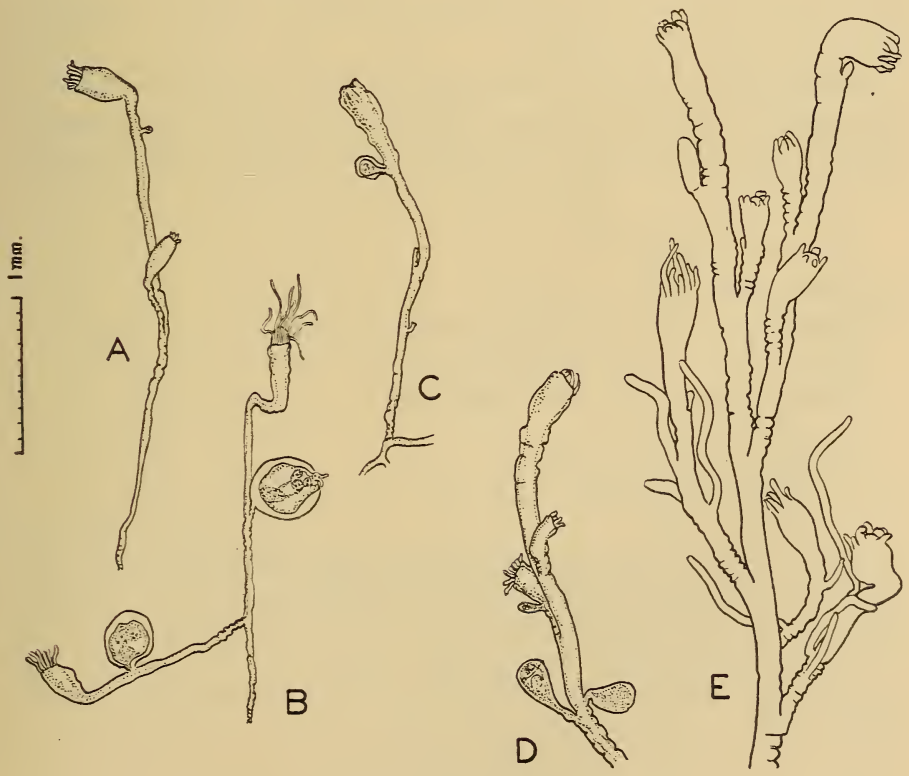

FIG. 1. *Bougainvillia macloviana* (Lesson) (A–C), and *Bougainvillia ramosa* (van Beneden) (D–E). A–C, 3 stems from SH 255B showing gonophores in various stages of development. D–E, two portions of a colony from SH 429D showing filamentous appendages and young gonophores.

Bougainvillia ramosa (van Beneden) 1844

Fig. 1, D–E

Bougainvillia ramosa. Allman 1872, p. 311; pl. 9, figs. 5–7. Russell 1938, p. 152; 1953, p. 153, fig. 74 A–C. Vervoort 1946, p. 135, figs. 52A, 53.
Bougainvillia vanbenedeni. Jäderholm 1909, p. 46; pl. 3, fig. 5.

Material. A bushy, well-preserved colony reaching a maximum height of 1·8 cm. (SH 429D), a single sterile stem of 0·8 mm. (SH 403), and a badly preserved sterile colony with most of the hydranths disintegrated and reaching 1·2 cm. (SH 1A).

Description. Stem unfascicled or weakly fascicled near base, increasing in diameter from base to distal end, irregularly branched, or branches roughly alternate in the distal regions. Perisarc smooth with very occasional groups of corrugations on stem, corrugated or annulated on origins of branches, corrugated partly or wholly on hydranth pedicels, continued over hydranth to base of tentacles as 'pseudohydrotheca'. Filamentous appendages given off profusely from stem, branches or hydranth pedicels, reaching a maximum length of 2·35 mm., occasionally branched.

Medusa buds scarce and present (in February) in the lower regions of the colony only, mostly very young. Marginal bulbs visible, with stumps of 2 tentacles to each. Sections through the oldest stage show the beginnings of 4 oral tentacles.

Nematocysts of two types:

i. Microbasic euryteles, 8·0 × 3·0 μ.

ii. Desmonemes, 4·0 × 2·5 μ.

Measurements (mm., preserved, including perisarc)

Stem, unfascicled part, diameter	0·08–0·20
Hydranth, approximate maximum length	0·66
maximum diameter	0·33
Gonophore, maximum length	0·28
maximum diameter	0·22
pedicel, length	0·07–0·15

Remarks. This material can be assigned to forma *benedeni* Bonnevie 1898, which has been included in *B. ramosa* by most modern workers. It resembles very closely Jäderholm's figure (1909, pl. 3, fig. 5), except that the stem is almost completely smooth.

B. ramosa has been reported from several localities on the south coast by Stechow 1925.

Rhizorhagium navis n. sp.

Fig. 2

Holotype. SH 429B, from the hull of a vessel which had not left Table Bay, collected 10/2/58. (S.A.M. registered number H 124.)

Description. Colony creeping on weeds, other hydroids, etc. Hydrorhiza giving rise to upright stems, each bearing a single terminal hydranth and reaching a maximum height of about 5 mm. Hydrorhiza and stem covered with perisarc, which terminates below the hydranth. Stem usually increasing in diameter from the base upwards. Perisarc irregularly wrinkled or corrugated in parts, particularly near the base, often terminating in a swollen rim.

Hydranth with conical hypostome and 8–16 tentacles arranged in two close, alternating verticils and held alternately elevated and depressed. Mouth widely distensible and occasionally turned completely inside out.

Gonophores in the form of fixed sporosacs, borne on the stem below the hydranth in an irregular fashion with the youngest above and the oldest below, up to 8 per stem, male and female on separate colonies. Gonophore and its pedicel covered with perisarc, which is thick below and very thin in the distal region. Gonophores cryptomedusoid, without tentacle rudiments or radial canals.

Male gonophores ovoid, with terminal opening, bearing the sexual products around a swollen and hollow spadix.

Female gonophores ovoid, tapering below to short pedicel. Spadix swollen and hollow, filling the gonophore in the proximal half, and bearing about 8 eggs, but often more, around the narrowed distal portion. Eggs developing into planulae while still attached to the gonophore.

Nematocysts of 2 kinds:

i. Desmonemes, $3{\cdot}5 \times 2{\cdot}0\ \mu$.

ii. Microbasic euryteles, $6{\cdot}5 \times 3{\cdot}0\ \mu$. Capsule elongated, slightly asymmetrical, aperture off-centre. Butt about $\frac{2}{3}$ length of capsule, thread coiled transversely. Spines on butt not clearly determined.

Colour: creamy white, with pink tinges in the hypostome of the hydranth and spadix of the gonophore.

Development of gonophores. This material was kept alive for two weeks in the laboratory, during which time the development and maturation of the gonophores was observed.

Gonophores of both sexes appear first as spherical hollow buds, covered by ectoderm and endoderm (fig. 2B). Each bud lengthens and becomes pear-shaped, and at the distal end, between ectoderm and endoderm, appears a solid mass of cells, the entocodon (fig. 2C). As the gonophore continues to elongate the proximal part of the endoderm remains closely applied to the ectoderm so that the internal cavity of the spadix is spacious in this region, but the distal part is narrow and separated from the ectoderm by the entocodon which forms a sort of cap over it. The entocodon is now 2-layered, with a shallow subumbrellar cavity between the layers, which is more evident in the female than in the male. The inner layer of the entocodon is thicker than the outer and in it the sex cells accumulate. A thin endodermal lamella is visible

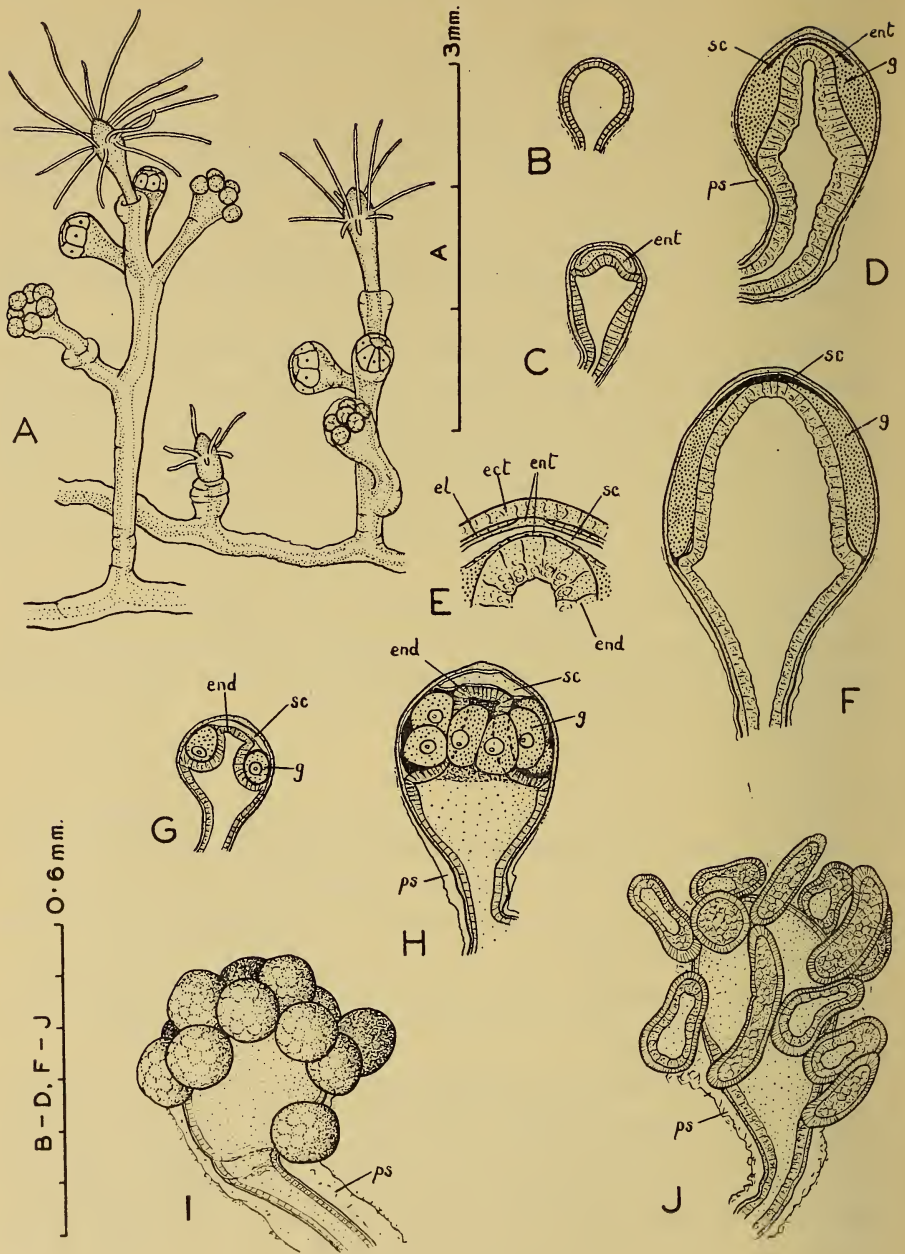

FIG. 2. *Rhizorhagium navis* n. sp.

A, part of a female colony drawn from living material. B–J, stages in the development of the gonophores drawn from whole mounts. B, a young male gonophore. C and D, later stages in development of male gonophore. E, the distal region of stage D on a larger scale to show details of layers. F, a mature male gonophore. G, a young female gonophore. H, a mature female gonophore. I, the female gonophore after the escape of the eggs, and J, with advanced planulae still attached. *ect*, ectoderm. *el*, endoderm lamella. *end*, endoderm. *ent*, entocodon. *g*, germ cells. *ps*, perisarcal covering. *sc*. subumbrella cavity.

between the entocodon and the ectoderm, but there are no radial canals or tentacle rudiments (fig. 2D, E, G).

In the fully formed male gonophore the spermatogenic cells surround the endodermal spadix for about two-thirds of the length, and this distal region is sharply demarcated from the transparent proximal region (fig. 2F).

In the mature female gonophore the distal part of the spadix, surrounded usually by a single tier of eggs, makes up about one-half of the length (fig. 2H). Subsequently, either before or just after fertilization, the eggs escape from the gonophore at the distal end, and with the release of pressure the spadix expands to fill the whole space (fig. 2I). The eggs remain attached to the gonophore by a gelatinous perisarcal envelope and here develop into planulae which reach an advanced stage before they finally escape (fig. 2J).

Measurements (mm., preserved)

Hydrorhiza, diameter	0·08–0·14
Stem, diameter	0·08–0·26
Hydranth, length from perisarc, normal position	0·39–1·29
maximum diameter, normal position	0·19–0·53
Gonophore (without pedicel), male, length, reaching	0·62
diameter, reaching	0·44
Gonophore, female, length, reaching	0·50
diameter, reaching	0·35

Remarks. This material differs from most species of *Rhizorhagium* in that the gonophores are borne on the stem instead of on the hydrorhiza. It resembles most closely *R. robustum* (Warren) 1907 from Natal, but differs in the absence of perisarc over the base of the hydranth, in the presence of more than one gonophore per stem, and in the size and structure of the gonophore itself.

Family **Campanulariidae**

The classification of the Campanulariidae is one of the most vexed questions in hydroid systematics. Among modern workers there are two main schools of thought: that of Broch (1918) who admits only two genera, *Campanularia* and *Laomedea* (excluding *Silicularia*), and who is followed by most continental workers such as Kramp and Vervoort; and that of Stechow (1923c) who recognizes as many as 17 genera.

Broch has distinguished his two genera mainly on the nature of the diaphragm, and has discounted the method of reproduction, whether by fixed sporosacs or medusae. His classification could not be accepted by medusa systematists, and contributes little towards what should be our ultimate object, a single composite classification for hydroids and their medusae.

While recognizing the fundamental importance of diaphragm structure, the author also agrees with Rees (1957) that separate genera should be retained for forms which produce free medusae and forms which produce fixed sporosacs.

The difficulty then arises that various grades of degenerate or imperfectly formed medusae occur in the family, and the grade may even differ in the two sexes. It is proposed therefore for the purpose of classification to consider as 'medusae' only those which are fully formed and which can be classified by the usual medusa keys, and as 'sporosacs' all imperfectly formed grades from the styloid to the eumedusoid types. Thus we can retain *Obelia* for branching forms with a true diaphragm and free medusae, and use *Laomedea* for branching forms with a true diaphragm and fixed gonophores (including *Gonothyraea*, *Hartlaubella* (= *Obelaria*) and *Campalaria*). *Clytia* can be retained for stolonial forms (which may also branch in the form of a drepanium) which produce free medusae. Stechow has shown that the diaphragm in the latter ranges from the 'Campanularia' type to the 'Laomedea' type, and that in this respect the genus is intermediate. The medusa is sufficiently different from that of *Obelia* for generic separation. *Campanularia* can then be retained for forms with an annular thecal thickening in place of a true diaphragm and which produce fixed gonophores. As such it will include *Orthopyxis* with its degenerate medusae.

Laomedea angulata (Hincks) 1861

Laomedea calceolifera. Stechow 1925, p. 438.
L. angulata. Broch 1933, p. 100, fig. 43. Vervoort 1946, p. 305, figs. 134b, 135.
Campanularia calceolifera. Millard 1952, p. 430.

Material. Two rich samples, both including male and female colonies with abundant gonangia (borne in December and February). Maximum height 2·3 cm. Record numbers: SH 327, 423.

Description. Structure and form of the colonies agreeing exactly with previous descriptions. Stem unfascicled, branched or unbranched. No filamentous appendages. Hydrothecae with slightly flaring margins.

Gonangia borne on the bases of the hydrothecal pedicels, usually alternately on the anterior and posterior surfaces. Young ones truncated at distal ends. Female gonangia containing a large number of eggs or fully developed planula larvae. Male gonangia containing gonophores swollen with spermatozoa.

Measurements (mm.)

Stem, diameter	0·10–0·15
Pedicel, diameter	0·08–0·13
Hydrotheca, height	0·37–0·58
diameter at margin	0·24–0·42
height/diameter	1·14–1·71
Gonotheca, female, length	1·00–1·30
diameter	0·39–0·57
Gonotheca, male, length	0·99–1·62
diameter	0·29–0·45

Remarks. See discussion.

Laomedea lovéni Allman 1859

Gonothyraea lovéni. Hincks 1868, p. 181; pl. 25, fig. 2. Allman 1871, p. 55, fig. 28.
G. loveni. Nutting 1915, p. 68; pl. 17, figs. 1–2. Millard 1952, p. 420, 440.
Laomedea loveni. Vervoort 1946, p. 310, fig. 137.

Material. 9 samples; rich colonies reaching a maximum height of 4·0 cm. Record numbers: SH 4, 8, 124, 239, 255A, 261A, 271, 429C, 430B.

Description. Stems slender and branching.

Hydrothecae, and particularly the margins, extremely thin-walled and delicate. Proportions variable, with length from 1½ to over 2½ times the diameter. Marginal teeth with the typical truncated shape, separated by rounded bays. No longitudinal striations.

Hydranth with 19–33 tentacles held alternately elevated and depressed, completely retractable into hydrotheca.

Gonangia abundant, containing up to 8 gonophores, of which as many as 5 may be extruded as meconidia at one time. Female meconidia containing about 5 planulae and bearing about 8 small tentacles. Male meconidia with about 5 tentacles of the same length as the female. Gonangia observed in January, February, and June to September.

Nematocysts of one kind only: basitrichous isorhizas, 6·7 × 2·2 μ. Capsule elongated-oval, symmetrical.

Measurements (mm.)

Hydrotheca, length	0·39–0·63
diameter at margin	0·18–0·37
length/diameter	1·59–2·73
Gonotheca, length, reaching	1·28
diameter, reaching	0·36

Remarks. Due to the extreme delicacy of the hydrotheca the measurements may not be wholly reliable, for in mounted specimens the margin is almost invariably damaged, and the side walls tend to fall in, making the whole structure appear narrower than it really is. For the same reason the base of the hydrotheca often becomes telescoped on the pedicel making the diaphragm appear oblique. In perfect, undistorted hydrothecae the length is usually slightly over twice the diameter, and the diaphragm is perpendicular to the hydrothecal axis. In end-on view there are very slight hollows on the outer surfaces of the teeth, but these are far too shallow to give any impression of striations in side view. This is the first record of the species from South Africa.

Obelia bicuspidata Clarke 1875

Laomedea bicuspidata. Vervoort 1946, p. 298, fig. 132; 1946a, p. 344, fig. 10.
Obelia bicuspidata. Millard 1958, p. 174.

Material. A small colony, reaching a maximum height of 6 mm., from a floating dock from Calcutta. Collected 20/2/48. Record number: SH 341.

Description. Stem unfascicled, unbranched or sparingly branched.

Hydrothecae rather small for the species and unstriated. The bicuspid nature of the marginal teeth is not evident at first sight, for the bays between members of a pair are practically equal in size to those between consecutive pairs, but an end-on view of a hydrotheca shows the typical polyhedral outline, with two internal keeled teeth arising from each plane.

Gonothecae present, but scarce.

Measurements (mm.)

Hydrotheca, length	0·34–0·42
diameter	0·18–0·22
length/diameter	1·59–1·89
Gonotheca, length	0·52–0·62
diameter	0·17–0·21

Remarks. This species has undoubtedly been transported from India, whence it has been reported by Annandale 1915 as *O. spinulosa.*

Obelia dichotoma (Linn.) 1758

Obelia dichotoma. Millard 1952, p. 420, 426, 433, fig. 3; 1957, p. 198; 1958, p. 174.

Material. Numerous samples, some very rich, from ships' hulls and experimental plates. Maximum height 4·5 cm. Record numbers: SH 6, 7, 160, 220, 228, ?256, 279, 340, 349, 395, 398, 409, 410.

Remarks. This species has been discussed in a paper on fouling organisms (Millard 1952). It settles mainly in the autumn, yet gonophores have been observed in February, March, May to July, and September.

Obelia geniculata (Linn.) 1758

Obelia geniculata. Hincks 1868, p. 149; pl. 25, fig. 1. Millard 1952, p. 420, 433; 1957, p. 198.

Material. Two samples from experimental plates, reaching a maximum height of 1·0 cm. Gonophores observed in March and June. Record numbers: SH 347, 353.

Family **Campanulinidae**

Lovenella chiquitita Millard 1957

Fig. 3

Lovenella chiquitita Millard 1957, p. 198, fig. 7.

Material. A fairly rich colony growing on barnacle shells and other hydroids. Record number: SH 430C (28/7/58).

Description. Pedicels arising directly from hydrorhiza or branching in a sympodial manner as often as nine times. Colony reaching a maximum height of 1·89 mm. Details of structure exactly as in original description.

Gonothecae plentiful, most of them empty, but two in the process of discharging medusae (here described for the first time).

Medusa at time of liberation without apical process or peduncle, with 8 unbranched marginal tentacles of which the perradial ones are longer than the interradial, without marginal or lateral cirri, with 8 closed adradial marginal vesicles each containing two concretions, with a short stomach and a simple quadrangular mouth, with narrow radial and circular canals, without gonads, measuring approximately 0·3 mm. in depth and 0·4 mm. in diameter.

Colour: living hydranths colourless. Medusa transparent, with brown patches on the bases of the tentacles and in the stomach.

Measurements. The measurements are completely within range of those quoted for the holotype and paratypes (Millard 1957), except for the gonothecae, some of which are slightly larger, the maximum size recorded being 0·70 mm. in length by 0·32 mm. in maximum diameter.

Remarks. Living material of this species was kept alive for a few days in the laboratory. One medusa was in the process of escaping from its gonotheca

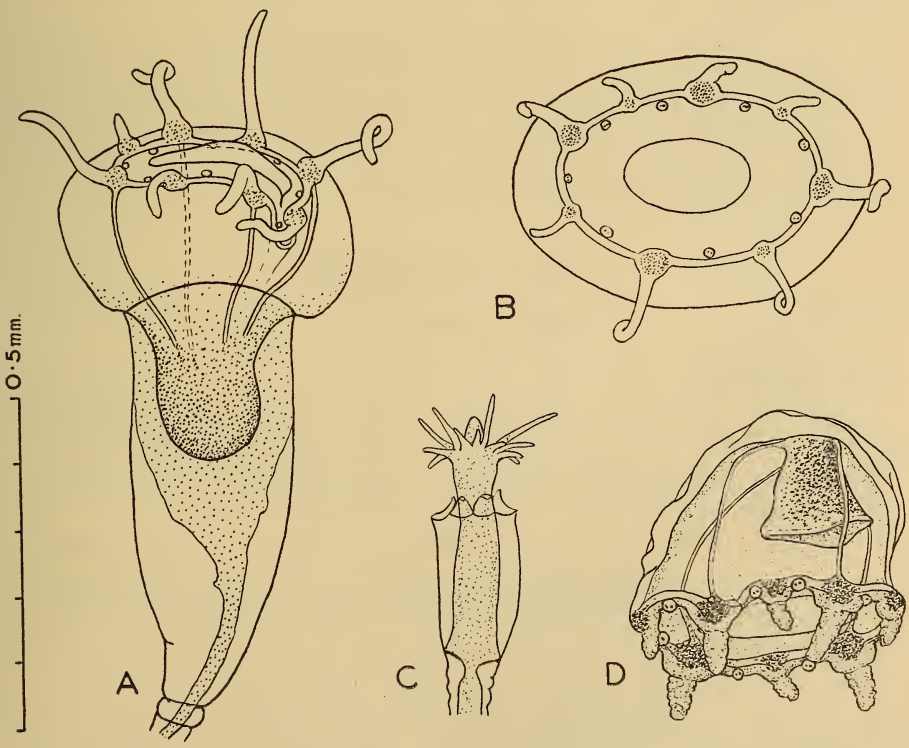

FIG. 3. *Lovenella chiquitita* Millard.

A–C from living material, and D from preserved material slightly shrunk. A, the young medusa escaping from the gonotheca. B, ventral view of newly liberated medusa. C, the hydranth, partially extended. D, lateral view of newly liberated medusa.

at the time of collection, but died 2 days later without becoming completely free. A second medusa successfully escaped 3 days after collection and was fixed and mounted.

The medusa, in the absence of lateral cirri, appears to belong to the genus *Phialella* as defined by Rees 1939 and Russell 1953, rather than *Lovenella*. These two genera, although closely related, are clearly distinguished by the presence or absence of lateral cirri in the medusa, and by the nature of the operculum in the hydroid, and are in fact usually placed in separate sub-families. We are now confronted by a species in which the hydroid generation belongs to one of these genera and the medusa to the other.

Kramp (1932a and earlier papers quoted therein) stresses the value of the hydroid operculum in distinguishing sub-families of Campanulinidae, *Lovenella* being included in the Calicellinae, and *Phialella* presumably in the Campanulininae, although the development of the operculum was described in only one species of the latter, namely *Campanulina lacerata* (Johnston). The important point is that the difference in the operculum in the two sub-families is the result of a fundamental difference in development and should therefore be of good systematic value.

In the present species the operculum clearly belongs to the 'Lovenella' type, and the only feature excluding it from this genus is the absence of lateral cirri in the newly liberated medusa. Since it is possible that lateral cirri may develop at a later stage it is proposed to retain the species in *Lovenella*, at least until such time as the mature medusa is known and the development of the operculum in *Phialella* is fully understood.

Family **Plumulariidae**

Kirchenpaueria pinnata (Linn.) 1758

Kirchenpaueria pinnata. Millard 1952, p. 420, 426, 433, fig. 3; 1957, p. 233.

Material. Abundant colonies from a variety of vessels and experimental plates. Maximum height of colony 4·1 cm. Record numbers: SH 13, 14, 77, 145, 209, 245, 270, 272, 280, 282, 285, 288, 291, 292, 304, 313, 326, 358, 359, 361, 365, 368, 430D.

Remarks. This species was discussed in a paper on fouling organisms (Millard 1952). Gonophores have been observed in January, February, July and October. Settling has been observed in most months of the year but mainly in spring.

Plumularia setacea (Ell. & Sol.) 1755

Plumularia setacea. Hincks 1868, p. 296; pl. 66, fig. 1. Millard 1952, p. 420; 1957, p. 232; 1958, p. 212.

Material. Two small sterile colonies, with a maximum height of 0·7 cm. Both colonies fall within forma *typica* Broch 1914. Record numbers SH 1B, 200.

Discussion

In all, 14 species of hydroids have been reported from floating structures in Table Bay harbour, and an attempt was made to determine the origin of the species, whether local or foreign (Table 1). Theoretically a history of the vessels concerned (which had been fully recorded) should provide the answer, but in actual fact it was no easy matter. Many of the vessels had had long voyages with varied ports of call, often visiting Cape Town before their final dry-docking, and sometimes lying idle in port for weeks or even months. Such vessels might carry a mixture of foreign and local forms. Only one vessel (a floating-dock towed from Calcutta) could be said to carry exclusively foreign material, for she was dry-docked two days after arrival and had no time to accumulate local forms. On the other hand one must bear in mind that foreign species might be brought into the docks and reproduce there and even establish themselves, eventually settling on vessels which have never left the area.

	Experimental plates (local)	*Purely local vessels*	*Purely foreign vessels*	*Local+ foreign vessels*	*Total*	*Distribution*
Kirchenpaueria pinnata	17	5	–	1	23	cosmopolitan
Obelia dichotoma	6	4	1	2	13	cosmopolitan
Tubularia warreni	1	5	–	5	11	endemic to S. Africa
Laomedea lovéni	2	4	–	3	9	north Atlantic
Sarsia eximia	–	3	–	1	4	cosmopolitan
Bougainvillia ramosa	1	2	–	–	3	cosmopolitan
Plumularia setacea	1	1	–	–	2	cosmopolitan
Obelia geniculata	2	–	–	–	2	cosmopolitan
Bougainvillia macloviana	–	2	–	–	2	Antarctic
Laomedea angulata	–	2	–	–	2	north Atlantic and Falklands
Obelia bicuspidata	–	–	1	–	1	cosmopolitan
Tubularia larynx	–	1	–	–	1	cosmopolitan
Lovenella chiquitita	–	1	–	–	1	endemic to S. Africa
Rhizorhagium navis	–	1	–	–	1	endemic to S. Africa

Table 1. A list of the hydroid species in order of abundance, giving the number of records from various sources. 'Local' vessels include those whose itinerary was restricted to the South African coast.

Of the species listed, three, namely *Tubularia warreni*, *Lovenella chiquitita* and the new species *Rhizorhagium navis*, are endemic to the country and could only have a local origin. Yet the identity of *T. warreni* is by no means finally settled. The very fact that the species is characteristic of ships' hulls and harbour areas leads one to suspect that it is transported from place to place, and possibly from Europe to South Africa, by ships, and to doubt whether it should be held specifically distinct from such species as *T. mesembyranthemum* and *T. crocea* which are abundant in harbours elsewhere. Only a full knowledge of the variation of nematocysts in all related species can settle the problem.

Of the remaining species all, with the exception of *Obelia bicuspidata*, have been found on experimental plates or on vessels with a South African itinerary; some of the latter had never left Table Bay. *Kirchenpaueria pinnata*, *Obelia dichotoma*, *Plumularia setacea* and *Obelia geniculata* in addition are common round the South African coast, and can safely be assumed to have had a local origin. *Sarsia eximia*, *Bougainvillia ramosa* and *Tubularia larynx* are by no means common, but have all been recorded from the country on previous occasions.

Bougainvillia macloviana is an Antarctic form known to occur on ships' hulls (Vanhöffen 1910). It can apparently penetrate as far north as South Africa for it has been reported from off Borrocouto by Jäderholm 1923.

The records of *Laomedea angulata* and *L. lovéni* are interesting and suggestive, for both are north Atlantic species and, apart from one record of *L. angulata* from Simon's Bay (Stechow 1925) and one from the Falklands (Ritchie 1907a), they have apparently not been reported before from the Southern hemisphere. They appear to be recent colonizers of the harbour area, almost certainly transported there by ships from Europe or the Mediterranean. Although well established, for they settle readily on newly exposed areas, they have not spread to other parts of the coast. Stechow's record of *L. angulata* from Simon's Bay was possibly also an immigrant from northern waters.

Only two species are of exclusively foreign origin, and were found on the hull of the floating-dock from Calcutta mentioned above. These were *Obelia bicuspidata* and *O. dichotoma*. Both are cosmopolitan in distribution and both are also known from South Africa. *O. dichotoma* also occurs abundantly on local vessels and experimental plates. These records provide supporting evidence that species can be transported over long distances without serious inconvenience, and that the genus *Obelia* is particularly hardy in this respect, for the material was alive and reproducing freely on arrival.

In conclusion it is noteworthy that more than half (8 out of 14) of the species recorded here are cosmopolitan in distribution, and 3 at least are on the way to becoming so. One might pose the question: is their presence on ships' hulls a result of their world-wide abundance and ability to live under varied conditions, or is their wide distribution a result of transportation by ships?

Summary

A total of 14 species of hydroids is recorded. Amongst them is one new species, *Rhizorhagium navis*, and one new record for the country, *Laomedea lovéni* Allman. The medusa of *Lovenella chiquitita* Millard is described for the first time. The composition of the hydroid fouling fauna is discussed and suggestions made as to the origin of the species.

References

Allman, G. J., 1871–2. A Monograph of the Gymnoblastic or Tubularian Hydroids. Parts 1 and 2. London.

Annandale, N., 1915. Fauna of the Chilka Lake. The Coelenterates of the Lake, with an account of the Actiniaria of brackish water in the Gangetic Delta. *Mem. Ind. Mus.*, **5**, 65–114.

Broch, H., 1914. Hydrozoa benthonica, in *Michaelsen's Beiträge zur Kenntnis der Meeresfauna Westafrikas*, **1**, 19–50.

Broch, H., 1918. Hydroida, Part 2, in *Danish Ingolf-Exped.*, **5**, 1–205.

Broch, H., 1933. Zur Kenntnis der adriatischen Hydroidenfauna von Split. *Norske Vidensk.-Akad. Oslo, I. Mat.-Naturv. Klasse*, no. 4, 1–115.

Browne, E. T. and Kramp, P. L., 1939. Hydromedusae from the Falkland Islands. *Disc. Rep.*, **18**, 265-322.

Day, J. H., Millard, N. A. H. and Harrison, A. D., 1952. The Ecology of South African Estuaries. Part 3. Knysna: A clear open Estuary. *Trans. Roy. Soc. S. Afr.*, **33**, 367–413.

Ewer, D. W., 1953. On a new Tubularian Hydroid from Natal. *Ann. Natal Mus.*, **12**, 351–357.

Hawes, F. B., 1955. Notes on the Variation occurring in *Tubularia larynx* Ellis & Solander. *J. Mar. Biol. Ass.*, **34**, 333–346.

Hincks, T., 1868. A History of the British Hydroid Zoophytes, **1** and **2**. London.

Jäderholm, E., 1909. Northern and Arctic Invertebrates in the Collection of the Swedish State Museum (Riksmuseum). 4. Hydroiden. *Kungl. Svenska Vetenskapsakad. Handl.*, **45**, 1–124.

Jäderholm, E., 1923. Hydroids from West and South Africa. *Meddel. Göteborgs Mus. Zool.*, **26**, 1–7.

Kramp, P. L., 1932a. The Godthaab Expedition 1928. Hydroids. *Meddel. Grønland.*, **79**, 1–86.

Millard, N., 1952. Observations and Experiments on Fouling Organisms in Table Bay Harbour, South Africa. *Trans. Roy. Soc. S. Afr.*, **33**, 415–445.

Millard, N. A. H., 1957. The Hydrozoa of False Bay, South Africa. *Ann. S. Afr. Mus.*, **43**, 173–243.

Millard, N. A. H., 1958. Hydrozoa from the coasts of Natal and Portuguese East Africa. Part 1. Calyptoblastea. *Ann. S. Afr. Mus.*, **44**, 165–226.

Millard, N. A. H., 1959. Hydrozoa from the coasts of Natal and Portuguese East Africa. Part 2. Gymnoblastea. *Ann. S. Afr. Mus.*, **44**, 297–313.

Nutting, C. C., 1915. American Hydroids. Part 3. The Campanularidae and the Bonnevellidae. *Spec. Bull. Smithsonian Inst. Washington*, 1–126.

Rees. W. J., 1939. A Revision of the Genus *Campanulina* van Beneden, 1847. *Ann. Mag. Nat. Hist.*, ser. 11, **3**, 433–447.

Rees, W. J., 1957. Evolutionary Trends in the Classification of Capitate Hydroids and Medusae. *Bull. Brit. Mus. (Nat. Hist.), Zool.*, **4**, 455–534.

Ritchie, J., 1907a. The Hydroids of the Scottish National Antarctic Expedition. *Trans. Roy. Soc. Edinburgh*, **45**, 519–545.

Russell, F. S., 1938. On the Nematocysts of Hydromedusae. *J. Mar. Biol. Ass.*, **23**, 145–165.

Russell, F. S., 1953. The Medusae of the British Isles. Cambridge.

Stechow, E., 1923c. Zur Kenntnis der Hydroidenfauna des Mittelmeeres, Amerikas und anderen Gebiete. Teil 2. *Zool. Jahrb. Jena, Syst.*, **47**, 29–270.

Stechow, E., 1925. Hydroiden der Deutschen Tiefsee-Expedition. *Wissenschaftl. Ergebn. Deutschen Tiefsee-Exped.* 1898–1899, **17**, 383–546.

Vanhöffen, E., 1910. Die Hydroiden der Deutschen Südpolar-Expedition 1901–1903. *Deutsche Südpolar-Exped.*, 11 Bd., Zool., **3**, 269–340.

Vervoort, W., 1946. Fauna van Nederland. Aflevering XIV. Hydrozoa (Cl). A. Hydropolypen. Leiden.

Vervoort, W., 1946a. Exotic Hydroids in the Collections of the Rijksmuseum van Natuurlijke Historie and the Zoological Museum at Amsterdam. *Zool. Meded.*, **26**, 287–351.

Warren, E., 1907. On *Parawrightia robusta* gen. et sp. nov., a Hydroid from the Natal coast; and also an Account of a supposed Schizophyte occurring in the Gonophores. *Ann. Natal Mus.*, **1**, 187–208.

Addendum

The registered numbers of Hydroid type material previously described by N. A. H. Millard and deposited in the South African Museum collections have not been published and are added below. Numbers in parenthesis are University of Cape Town station numbers or serial numbers of the collection made by the S.S. *Pieter Faure* (PF).

Millard, N. A. H., 1955. 'New species of Hydrozoa from South Africa', *Ann. S. Afr. Mus.*, **41** (5); 215–222.

Hydractinia altispina. Cotypes: S.A.M. H87 (F274), S.A.M. H88 (CP258), S.A.M. H89 (B92).

Hydractinia kaffraria. Cotypes: S.A.M. H90 (BRE111A), S.A.M. H91 (HAM3Q). Paratype: S.A.M. H92 (SUN3N).

Zygophylax cornucopia . Holotype: S.A.M. H93 (FB131B). Paratypes: S.A.M. H94 (TB1B), S.A.M. H95 (FAL78S), S.A.M. H96 (FAL217N).

Millard, N. A. H., 1957. 'The Hydrozoa of False Bay, South Africa', *Ann. S. Afr. Mus.*, **43** (4); 173–243.

Hydractinia canalifera. Holotype: S.A.M. H97 (CP332).

Eudendrium deciduum. Holotype: S.A.M. H98 (FAL52V).

Halecium parvulum Bale, var. *magnum*. Holotype: S.A.M. H99 (FAL274R). Paratypes: S.A.M. H100 (FAL159L), S.A.M. H11 (PF405A), S.A.M. H30 (PF16287A).

Campanularia morgansi. Holotype: S.A.M. H24 (PF15675B). Paratypes: S.A.M. H7 (PF351C), S.A.M. H101 (FB119L), S.A.M. H102 (FAL26L), S.A.M. H32 (PF18232B).

Lovenella chiquitita. Holotype: S.A.M. H103 (FAL288J). Paratypes: S.A.M. H104 (FB131F), S.A.M. H105 (FAL108.O).

Hebella furax. Holotype: S.A.M. H34 (PF18293B). Paratype: S.A.M. H106 (FAL58Y).

Synthecium hians. Holotype: S.A.M. H107 (FAL214G).

Sertularella capensis. Holotype: S.A.M. H108 (FB114A). Paratypes: S.A.M. H109 (FB115D), S.A.M. H110 (FAL64L).

Sertularella falsa. Holotype: S.A.M. H111 (FB119C). Paratypes: S.A.M. H112 (FB131H), S.A.M. H113 (CP333B).

Millard, N. A. H., 1958. 'Hydrozoa from the coasts of Natal and Portuguese East Africa. Pt. I. Calyptoblastea.' *Ann. S. Afr. Mus.*, **44** (5); 165–226.

Halecium inhacae. Holotype: S.A.M. H114 (IN140H).

Clytia serrata. Holotype: S.A.M. H115 (MOR216C).

Zygophylax geminocarpa. Holotype: S.A.M. H59 (PF12308A).

Zygophylax infundibulum. Holotype: S.A.M. H36 (PF10781B).

Hincksella corrugata. Holotype: S.A.M. H85 (PF12456J).

Sertularella dubia Billard var. *magna*. Holotype: S.A.M. H54 (PF12028B).

Sertularella mediterranea Hartlaub var. *asymmetrica*. Holotype: S.A.M. H116 (IN49K).

Sertularia linealis Warren var. *longa*. Holotype: S.A.M. H117 (IN140E).

Kirchenpaueria adhaerens. Holotype: S.A.M. H118 (RHB52G).

Monostaechas natalensis. Holotype: S.A.M. H79 (PF12456C). Paratypes: S.A.M. H48 (PF11803AF), S.A.M. H76 (PF12392G).

Monostaechas faurei. Holotype: S.A.M. H58 (PF12028F).

Plumularia irregularis. Holotype: S.A.M. H119 (DBN70Q).

Halicornaria africana. Holotype: S.A.M. H120 (AFR1028B).

Halicornaria arcuata (Lamx.), var. *epizootica*. Holotype: S.A.M. H73 (PF12392D).

Thecocarpus giardi Billard, var. *solidus*. Holotype: S.A.M. H121 (AFR1028A).